Automated Bag in Box Assembly & Contents Fill

In GB0314815.2, the Applicant has proposed a particular implementation of a so-called Bag-In-Box (BIB) container.

Generally, BIB designation is applied to an impermeable bag liner within a carton.

To that broad proposition, the Applicant has contributed an intervening neck collar locating, bracing and support element.

This collar feature allows:

- accurate mutual registration or (self-)alignment of bag liner and carton outer;
- transfer, distribution or sharing of bag and carton loading by bag neck capture through a collar - itself supported in a bespoke carton recess or cut-out; and
- retention of the bag neck to allow torque closure of a screw cap.

Bag Contents Fill

GB0314815.2 sets out fill issues.

Thus, bag contents fill is a prime consideration for a contents manufacturer.

Generally, dedicated automated filling lines are employed for a bespoke BIB configuration.

Traditional bag fill typically prefaces insertion of a filled bag into a pre-formed carton assembly.

Insertion and cartoning themselves can be a mix of manual and mechanised steps.

Fill Machinery

Resources commitment inhibits packaging change, if incompatible with established filling machinery.

Hitherto, fill machinery for (semi-)rigid walled containers, such as blow moulded Jerrycans, has (often) been incompatible with that for BIB containers.

A wet fill environment, with contents spillage, and risk of degrading cardboard cartons is a factor.

Mechanised Erection

Mechanised carton case erection generally is well developed for closing and joining

carton flaps with tape and/or adhesive bonding.

However, cartoning mechanisation has not hitherto been integrated with automated bag filling.

Indeed bag presentation for fill and fill itself have traditionally been undertaken as separate steps, preparatory to bag insertion in a largely completed carton, aside from top closure flaps.

Bag Pre-Fill

In conventional BIB production, a bag is pre-filled and inserted (or dropped) into a partially erected carton, which is then closed around it.

An object of the present invention is to admit alternative BIB fill and erection techniques.

Statement of Invention

Some aspects of the present invention address refinement in production, assembly, erection and filling of BIB containers and component elements.

Certain variants in BIB design and construction are also envisaged.

Particular instances include:

- supplementary pre-fabricated handles - desirably a 'lay-flat', single sheet, fabrication;
- a deformable cushion floor able to withstand crushing, collapse and failure upon dropping;
- a bracing liner or sleeve;
- top and bottom end stacking plates;
- air cushion bag;
- pressure release valve effect;
- integrated neck collar and handle moulding;
- plastics sheet carton;
- neck collar integration with plastics sheet carton;
- integrated bag neck and location collar.

According to one aspect of the invention,
a BIB is assembled from a bag liner and carton,
juxtaposed - and mutually entrained -
such as by a bag neck retention rim -
prior to bag (contents) fill.

Rectangular 3-D Bag

A preferred bag format has a generally rectangular, flat bottom, 3-D erect configuration, for closer conformity with a rectangular carton outer case.

Continuous Bag Web & Discrete Carton Blanks

A continuous web of collapsed bag portions with respective fill/discharge necks is conjoined with a succession of multiple discrete formative carton elements such as collapsed carton blanks.

Locating Collar

A locating collar, such as of GB0314815.2, is desirably fitted upon a bag neck.

Such a collar can overlie an inset step or recess in a carton (top) end flap, and sit beneath a neck retention rim, flange or lip.

This gives an anti-torque seat, which resists bag neck turning upon screw closure cap fitting and removal.

Side wall panels of carton blanks are wrapped around collapsed bags, preparatory to flap joining.

Local adhesive bonding, taping and/or interlocking edge profiling may be employed.

Handle

An optional pre-fabricated handle element may be attached to the carton top or side panels.

The handle is desirably a 'lay-flat', single sheet, fabrication.

Alternatively, an integrated handle and collar top-plate may be fitted to the carton.

Sub Assembly

This creates an intermediate sub-assembly which may adopt and preserve a compact, 2-D collapse-folded, flat-pack, configuration preparatory to final erection into a 3-D enclosure, assembly and fill.

This sub-assembly lends itself to compact storage and transport to a remote final erection, assembly and fill stage.

Erection by Bag Inflation

BIB container 3-D erection, from a collapsed 2-D form, is achieved by introducing fluid - say air - under pressure through a bag neck, to inflate the bag.

Bag inflation takes a carton shell along with it - through snap-action erection about pre-formed carton edge creases / folds - until the carton assumes a pre-disposed (rectangular) volumetric form.

Thus a collapsible flat-pack, but otherwise (sub) assembled BIB configuration can be contrived.

This preserves compact collapsed flat-pack (sub-) assembled format for space-efficient storage and shipment - rather than shipping a bulky container void, as with, say, a traditional Jerrycan.

On-site erection could be undertaken at a fill station.

That said, pre-assembly and erection to an empty BIB carton form can be undertaken preparatory to shipment to a remote fill station.

Bag / Carton Clearance Void

Generally, it is advantageous to preserve a certain 'clearance void' between carton and bag, to allow relative bag displacement upon impact.

Cushion Floor

A collapsible cushion floor pad insert may be inset between an outer carton and inner bag to bolster shock absorbency in the event of carton drop.

A deep or multi-layer corrugated cardboard sheet sandwich layer may fulfil this role.

Otherwise there is a risk of bag rupture and contents bursting upon local carton wall deformation or failure.

Cushion (Air) Bag

Features of a clearance void and cushion floor could be combined in a cushion bag - that is a discrete, say air inflated, capsule between contents bag proper and carton base and/or top.

Such a cushion bag could also be integrated with a contents bag proper.

An example would be a double-wall or skin.

Effectively, a bag would constrain contents within an inner liner and entrain (cushion) air between inner and outer liner.

Such an air capsule could compress more readily than liquid contents and so form an intermediate, energy dissipating, shock absorbing buffer.

Such a configuration may be particularly useful for relatively large capacity (eg some 25 litre) BIB variants.

Alternatively, a discrete self contained subsidiary (air) cushion bag could be carried or attached to the contents bag proper.

Preferably, such a cushion bag would be inflated prior to insertion into a carton.

Release Valve

A preset blow-off valve could allow controlled discharge of a buffer capsule upon a certain compression load threshold.

In practice, a carton top recess or step, for a locating collar, could serve as a safety displacement element upon BIB drop.

Thus, upon carton crush from below (i.e. upon drop) the bag within is displaced upward.

This in turn forces outward a carton recess and entrained neck collar and bag neck - for less constrained bag displacement.

Otherwise, were a carton a solid rectangle, a bag would have nowhere to redistribute - and would be forced against the carton top, with risk of carton and/or bag burst.

Reinforcement / Bracing Sleeve

A supplementary reinforcement or bracing sleeve or collar may be fitted between carton and bag, to help absorb shock impact load.

A deep or multi-layer corrugated cardboard sheet sandwich sleeve may fulfil this role.

This obviates changing entire carton wall gauge for exceptional conditions.

Corrugated Carton

Indeed an entire carton could be fabricated from corrugated thick wall cardboard for an inherently very robust construction - which could obviate the need for a bracing liner.

Plastics Sheet Carton

Thin sheet, laminated or corrugated synthetic plastics material might be employed for specialist application where economics justify.

Features such as a neck collar and/or handle could be integrated into such plastics sheet, say by local (vacuum) moulding or die cutting, with judicious use of heat to soften material.

Rectilinear Grouped Form

A regular, rectilinear, and in particular rectangular, carton format, with neck inset within a neck collar in a top panel recess or cut-out allows closely inter-nested rectilinear grouped stacking and packing.

Such rectilinear grouping admits of more orderly shipment than, say, rounded edge Jerrycans with irregular top surfaces with protruding fill necks.

Mixed Carton Sizes

Mixed size cartons of proportionate scaled relative volume and size multiples can be stacked together - without undermining stability or space utilisation.

Cluster Pack

Clustered or grouped multi-packs can be part enshrouded by a common wrap, sleeve or minimal opposed (top and bottom) cluster or stacking plates, say entrained by tie bands.

Shrink Wrap Palletisation

Larger and multi-layered stacks can be grouped upon a common pallet.

Collective shrink-wrapping of such a palletised stack creates a unified, robust, load shipping format.

A strictly rectangular outer profile and careful relative sizing and proportions allow intimate wall surface contact - and so mutual bracing in a stack.

Collective Scaled Print Image

With homogenous, abutting, carton forms, an entire carton surface can be over-printed, so a grouped carton collection can portray an enlarged graphic image from individual carton elements.

Such a jigsaw image effect could be used to cross-check correct carton grouping and alignment.

Leak Test

Bag pre-inflation could be used as a pressurised leak test, by monitoring inflated bag sealing integrity, prior to filling.

To this end a bag could be subjected, albeit temporarily, to somewhat higher pressures - or pressure differentials across a boundary wall - than it would normally be expected to withstand.

Aside from identifying (and so pre-empting from operational use) rupture and burst vulnerabilities, such as along heat weld seams, lesser, albeit longer term insidious leakage, such as between neck and bag joint, can be assessed, by monitoring the ability of a bag to sustain a given start pressure.

A valve in a fill head could allow both functions in a single bag neck capture through one-way fill and opposite way exhaust, with a measurement gauge tapping to the bag interior.

Such functionality could be achieved by bespoke design or adapting an otherwise conventional so-called 'plunging or diving head' filler.

A fill head, with integrated check valve, makes temporary sealing contact with a bag neck or neck collar for a fill cycle.

Reject Disposal - Recycling

In an automated erection and test line, provision could be made to off-load a rejected 'failed' bag, say by releasing it to a waste collection hopper.

Collected bags could be disposed of by plastics recycling.

The nature of the bag plastic lends itself to recycling more than, say, semi-rigid walled Jerricans.

Any entrained carton with a rejected bag could be released and, if undamaged, returned to a sub-assembly line for re-use - or simply disposed of by cardboard recycling.

Contents Fill Inflation

Although bag inflation for outer carton erection can be undertaken as an intermediate step, preparatory to contents fill, that fill step could itself be used for initial inflation and erection.

That is, the bag could remain collapsed until final fill.

Progressive Fill

Uninflated bag capacity is initially at a minimum and offers modest resistance until an inflated internal void is created upon bag erection.

To reflect this, a progressively increasing fill pressure and/or flow regime could be adopted.

This would obviate bag shock, fill line blow back and trigger of over-pressure release valves.

This also allows the inflating bag to take an outer carton form along with it from a collapsed 2-D flat-pack to an erect 3-D form.

If fill rate is a priority, more abrupt and faster, pre-erection, such as by air inflation can be employed.

Embodiments

There now follows a description of some particular embodiments of automated BIB assembly and contents fill according to the invention, by way of example only, with reference to the accompanying (diagrammatic and schematic) drawings, in which:

Figure 1 shows a flow chart of principal operational steps in BIB constituent element assembly;

Figures 2A and 2B show a BIB sub-assembly sequence;

More specifically,

Figure 2A shows a schematic BIB sub-assembly sequence;

Figure 2B shows a flow chart of principal operational steps in the sub-assembly sequence of Figure 2A;

Figures 3A and 3B show BIB erection and final assembly;

More specifically,

Figure 3A shows a schematic BIB erection assembly from the sub-assembly of Figure 2A;

Figure 3B shows a flow chart of principal operational steps in the erection and final assembly sequence of Figure 3A;

Figure 4 shows multiple simultaneous pre-inflation and/or fill detail in the erection and final assembly sequence of Figures 3A and 3B;

Figures 5A and 5B show variant BIB sub-assembly and erection sequences;

More specifically,

Figure 5A shows a continuous segmented carton web fed variant BIB sub-assembly sequence to that shown in Figure 2A;

Figure 5B shows a variant BIB erection sequence to that shown in Figure 3A in continuation of Figure 5A sub-assembly;

Figures 6A and 6B show optional insertion of elements during the erection and final assembly sequence of Figure 5B;

More specifically,

Figure 6A shows insertion of a cushion floor into the carton before final end flap closure;

Figure 6B shows insertion of a reinforcement or bracing sleeve into the carton before end flap closure;

Figures 7A and 7B show optional rectilinear grouping of erect BIB assemblies employing top and bottom stacking plates entrained by tie bands;

More specifically,

Figure 7A shows the rectilinear grouping of similar sized BIB cartons;

Figure 7B shows the rectilinear grouping of different sized BIB cartons;

Figures 8A and 8B show further variant BIB sub-assembly and erection sequences;

More specifically,

Figure 8A shows a variant BIB sub-assembly sequence to that shown in Figure 5A, from respective rolled carton and bag webs;

Figure 8B shows a variant BIB erection sequence to that shown in Figure 5A, employing the sub-assembly of Figure 8A;

Figures 9A through 9H show a variant BIB assembly sequence;

More specifically,

Figure 9A shows a carton blank element;

Figure 9B shows the carton blank of Figure 9A configured to form a tube wrap or

sleeve;

Figure 9C shows the carton of Figure 9B with closed top flaps;

Figure 9D shows (pre-) inflated and/or filled bag insertion into the bottom of the carton of Figure 9C;

Figure 9E shows the combined carton and bag of Figure 9D with closed bottom flaps and a collar fitment;

Figure 9F shows the assembly of Figure 9E with collar in place.

Figure 9G shows the assembly of Figure 9F with optional handle attachment;

Figure 9H shows the assembly of Figure 9G with optional integrated handle and collar top-plate;

Figure 10 shows a further variant BIB assembly sequence of multiple discrete carton wrap and fold around respective discrete pre-inflated/filled bags - before collar and optional handle attachment;

Figures 11A through 11C show a variant BIB sub-assembly sequence to that shown in Figures 2A, 5A, and 8A;

More specifically,

Figure 11A shows in detail an unrolled web of contiguous bags overlaid by individual carton blanks before collar attachment;

Figure 11B shows a carton blank wrap around a bag;

Figure 11C shows the arrangement of Figure 11B with completed carton wrap around a bag and edge joined;

Figures 12A and 12B show entrained box or carton and bag sub-assemblies, in a stackable flat-pack configuration, ready for transport, storage or erection and contents fill;

More specifically,

Figure 12A shows an individual carton and bag set upright - in this instance with bag outside a carton wrap ready for insertion through a top opening;

Figure 12B shows stacked cartons and respective bags - allowing a bag set within a carton wrap;

Figures 13A through 13C elaborate upon bracing sleeve insertion into a carton of Figure 6B;

More specifically,

Figure 13A shows an erected bracing sleeve liner juxtaposed for insertion into an open-ended top of a carton;

Figure 13B shows a completed BIB carton with internal bracing sleeve depicted in broken lines;

Figure 13C shows an enlarged view of a corner of the bracing sleeve of Figure 13A, showing corrugated material;

Figures 14A and 14B show a robust carton variant fabricated entirely of corrugated card (or plastics);

More specifically,

Figure 14A shows a corrugated carton with open top flaps;

Figure 14B shows an enlarged view of the corrugations in the carton of Figure 14A;

Figures 15A and 15B show an inset collar recess or step outward reversal, acting as a safety valve upon BIB (drop) impact;

More specifically,

Figure 15A shows initial BIB drop impact with resultant carton bottom (corner) crush deformation;

Figure 15B shows resulting collar recess ejection and support step outward hinge, admitting bag displacement;

Figure 16 shows a BIB variant with internal top cushion (air) bag;

Figures 17A through 17C show insertion of an integrated bag and collar into an erect carton;

More specifically,

Figure 17A shows bag and carton juxtaposition;

Figure 17B shows bag profile squeeze insertion through a carton top opening; and

Figure 17 C shows a final bag in carton assembly;

Figure 18 details collar and bag anti-torque restraint within a carton recess for screw closure cap tightening and loosening;

Figures 19A and 19B show a synthetic plastics sheet carton variant with integral moulded collar;

More specifically,

Figure 19A shows a sheet plastics carton blank with integral moulded collar;

Figure 19B shows the sheet plastics carton blank of Figure 19A fully erected;

Figures 20A and 20B show a variant of the sheet plastics carton of Figures 19A and 19B - with additional handle cut-out;

More specifically,

Figure 20A shows a sheet plastics carton blank with integral moulded collar and handle cut-out;

Figure 20B shows the sheet plastics carton blank of Figure 20A fully erected.

Referring to the drawings ...

Constituents

Figure 1 depicts an assembly sequence flow chart of principle constituent BIB elements, namely:

- box or carton 11;
- bag 12;
- locating neck collar 14 - per GB0314815;
- (optional) discrete (side/top) handle 13;

The bag 12 features an integral neck pourer or spout for contents fill and discharge.

A preferred bag manufacture (not shown) produces a continuous web of mutually edge-entrained, collapse folded bags.

That said, discrete bags (say either produced individually or separated from a web) can be used, as discussed in later embodiments.

Handle - Handling

Generally, for handling ergonomics, discrete neck collar 14 and handle 13 are disposed at opposite sides of a carton body 11.

A handle allows a user both to support filled weight and control the angle of tipping - and so rate of pouring.

A tall (say, pull-up) handle upstand at the neck collar 14 is feasible.

Supplementary handle cut-outs in the body (that is top and/or side walls) of carton 11 are readily provided upon carton blank die cutting.

In some variants, the collar 14 and handle 13 could be integrated - say by adopting a common (vacuum) moulding plate or strip.

Such an integrated handle and neck collar could form an overall carton top plate, providing shape bracing and support to a stacked overlying carton.

Flat Pack Sub-Assembly

These various elements are brought together in a compact collapsed, flat-pack sub-assembly 20 - for 'dense' (ie space efficient) bulk stacking and packing, to supply a remote fill station.

Final pack erection and completion (closure and sealing), to a pre-fill assembly 30, can be undertaken upon sub-assembly 20 in a subsequent distinct step at a fill station, on a user's premises, upon draw-down from a local store or repository.

Thus a fully erect 3-D volumetric form is not assumed until necessary to accommodate contents.

In this schema no wasteful void space is consumed in transport or storage until call-off just preparatory to fill.

However, if space is not at a premium, empty erected forms can be transported and stored - relieving the fill plant of the need for an inflation/erection station.

Automated Assembly

Although special-purpose machinery and operation is involved with BIB, certain (sub-)assembly steps can be derived by adaptation of conventional case erection packaging machines and technology.

This represents an economic advantage if a user is converting from traditional semi-rigid walled cartons to BIB, but already has certain packaging equipment.

The drawings are thus intentionally merely indicative and illustrative of broad principles, rather than necessarily detailed engineering solutions.

Sub-Assembly

Figures 2A (conveyor side elevation) and 2B (sequenced flow chart) depict in more detail creation of sub-assembly 20 of Figure 1.

Bag Web

Bags are produced as continuous web 55 of conjoined individual bag elements 51.

A web 55 of conjoined bags 51 is stored concertina-folded in a cassette store or repository 50.

The bags 51 are progressively retrieved from the store 50 by orderly unfolding and presented in a line, with necks 52 uppermost, upon a conveyor bed 80.

Carton Stack

Multiple discrete cartons 41 are stacked, one above another in corresponding orientation, as individual cut pre-folded carton blanks, in a cassette store 40, ready for individual pick-off and deposit upon a corresponding individual bag 51.

Carton Blank

Figure 9A shows laid-flat carton blank detail, with extended top 42, 48, 56 and bottom 57, 58 closure flaps and optional handle cut-outs 44.

The span of bottom side flaps 57 allows mutual overlap upon flap fold up - to cover the whole of the base area.

Bottom end flaps 58 then fold over - to provide three complete layers of material on the base and thus bolster carton robustness.

End flaps 58 are off-set (i.e. one longer than the other) to mirror the off-set of the top flaps 42, 48 in accommodating the collar 14.

Thus a single off-set tape machine (not shown) may be used (simultaneously) to seal both top 42, 48 and bottom 58 flaps.

Neck Aperture

A carton top flap 42 has a pre-cut neck aperture 43 to receive and locate a neck 52 of a bag 51.

Neck aperture 43 diameter is sufficient to pass, with modest local distention, and remain entrained under, a retention rim (not shown) upon bag neck 52.

Radial slits (not shown) about aperture 43 create locally a segmented periphery for such distension.

Pick'n Place

A pick'n place arm (not shown) deposits an individual carton 41 upon an associated bag 51, with the help of lateral conveyor guides 81 and an index locator finger (not

shown) for a bag neck 52.

By drawing bag web 50, successive bags 51 are 00indexed, incrementally or continuously, over conveyor bed 80, through successive work stations for carton 41, collar 14 and (optional) handle 13 fitment.

Collar

A cassette store 60 of stacked pre-fabricated (eg vacuum moulded shell) neck collars 14 is disposed over the conveyor 80 to deposit an individual collar upon an upstanding bag neck 52.

Collar 14 is superimposed upon a carton top flap 42.

A collar aperture 61 is sufficient to pass, with modest temporary local deformation, over neck retention rim - so that both carton top flap 42 and collar 14 are held captive between retention rim and bag 51.

Collar aperture 61 profile can be adapted - say with radial peripheral slits or otherwise segmented - to facilitate local distension for fitment and to secure bag neck 52 when a screw cap is applied.

The effect is to impart an anti-torque or torque resistant entrainment of bag neck in relation to (screw) cap closure fitment.

Handle

A supplementary discrete handle 13, can be fitted to a carton top flap 42 and side edge 45 at a handle installation station 90.

A pre-fabricated (moulded) 'lay-flat' profile is convenient for handle 13.

Such a handle 13 can be secured by local adhesive bonding.

In addition, or alternatively, reliance can be placed upon handle cut-outs in the carton body.

In some variants, handle 13 could be integrated with collar 14 - in which case a combined store and mounting station could be contrived.

Concertina Stacking

Carton 41, bag 51, neck collar 14 and (optional) handle 13 are fitted to create a sub-assembly 20.

A succession of sub-assemblies 20 is mutually entrained in a sub-assembly string or web 71,

Web 71 is drawn into a concertina-folded stack in a sub-assembly cassette store or repository 70.

Sub-Assembly Review - Overview

Flat Pack

The overall assembly sequence involves:

- bringing together into juxtaposition a collapsed bag 51 and collapsed carton 41,
- with insertion of an intervening location collar 14 according to GB0314815,
- so preserving a compact collapsed flat pack individual sub-assembly 20 form in a sub-assembly string 71.

A bag neck 52 of an individual bag 51 is orientated upward as an upstand for registration and location of an aperture 43 in a top flap 42 of a carton 41.

An automated BIB carton assembly line 100 is fed by a continuous web 55 of bags 51 and a stack 40 of collapsed cartons 41.

A conveyor 80 draws the web 55 along an assembly path, at which successive individual cartons 41 are extracted from the stack 40 and laid upon an associated bag 51.

A carton 41 is presented to an underling bag 51 with a top flap 42 and neck locating aperture 43 deployed in mutual registration.

Side and/or end flaps 46 are in-turned and joined, using tab 19, to create a carton sleeve or wrap 47 about each bag 51.

This leaves top 42, 48, 56 and bottom 57, 58 (closure) flaps to be deployed and mutually entrained - upon conversion from a 2-D collapsed form to a 3-D erect form.

A collar storage cassette 60 with a discharge driving plunger (not shown), delivers and installs individual collars 14 to each bag neck 52, with a spring clip insertion and location action.

Collar 14 effectively holds the carton top flap 42 with neck locating aperture 43 captive with the bag neck 52 - and thus entrains overall carton 41 and bag 51.

The bag neck 52 serves as a locating upstand, to help preserve bag 51 and carton 41 registration and alignment - also aided by lateral conveyor guides 81.

Thus successive cartons 41 are entrained upon respective individual bags 51 of the bag web 55.

The entrained bag web 55 and carton 'string' 71 is concertina folded in a storage cassette 70.

Storage cassette 70 is conveniently a portable container, which can be transported to a remote final assembly and fill station, as now described.

Collapse Folded Flat Pack Sub-Assembly

The overall outcome of Figures 2A and 2B sub-assembly stage is a compact, collapsed-folded, flat-pack of mutually entrained or captive bag 51, carton 41, neck collar 14 and (optional) handle 13, in a sub-assembly string 71.

Final Assembly & Erection

Figures 3A and 3B depict final assembly and erection to transform a 2-D collapsed flat pack sub-assembly 71 of Figure 2 into an erected fully assembled 3-D form 150 ready for contents fill.

Preparatory Bag (Test) Inflation

In this schema, an intermediate preparatory bag (test) inflation is undertaken preparatory to carton 41 closure fully to envelop the bag 51.

Contents Fill

In an alternative schema, initial bag 51 inflation is through contents fill - that is bypassing a preliminary test inflation.

The sub-assembly cassette store 70 is emptied by progressively withdrawing a sub-assembly string 71 based upon an original bag web 55.

Individual bags 51 are presented to a preliminary inflation test station 110 with necks 52 uppermost.

This orientation also corresponds to the stacking orientation at the conclusion of the sub-assembly stage of Figure 2.

Bags 51 are supported by a conveyor bed 120.

Simultaneous connection is made to multiple bag necks 52 through multiple individual valve caps 111, with respective umbilical feed pipes 112 to an air pressure supply 113, through a rotary swivel connector valve 114 (detailed in Figure 4).

Individual bags 51 are captured with a valve cap 111 and a retention rim locating collar (not shown) to bear bag 51 and contents weight.

Until fitment of valve cap 111, and capture by a neck retention rim location collar, successive bags 51 remain mutually entrained in original continuous bag web 55 - and

are thus to an extent self-registered.

Upon valve cap 111 and rim locator fitment, bags 51 are mutually severed - so breaking or fragmenting the former continuous web 55.

Severance is conveniently undertaken along a pre-scored weakening line, using a (slicing rotary or guillotine) knife blade (not shown).

Upon mutual severance, individual bags 51 are free to adopted independent positions and orientations in relation to successive, formerly adjoining, bags 51.

Whilst a bag 51 is held captive by its neck 52, its body is free to hang down - suspended by retention rim, itself configured to withstand such support loading.

Similarly, a carton 41 is held captive by entrapment of its top flap 42 beneath the bag retention rim.

However, the bulk of carton 41 is free to swing down about a top flap corner edge fold 49.

Air (Pre-Fill) Inflation

Bag 51 and carton 41 gravity suspension is triggered by air pressure feed to cap valve 111 - progressively to inflate, and so distend bag 51 walls from a collapse folded 2-D condition to an erect 3-D form.

Air Pulse

An air pulse can be employed to disturb initial juxtaposed bag 51 and carton 41 disposition.

Successive individual separated bags 51 are carried upon conveyor 120 to an end flap closure station 130 and onward to a contents fill station 140.

Multiple Pre-Inflation / Fill

Figure 4 shows a plan view of multiple simultaneous pre-inflation and/or fill detail in the erection and final assembly sequence outlined in Figure 3A.

A spider web array of fill lines 112 radiates from a common central feed head 113 with a swivel joint and seal.

Individual fill caps 114 traverse a continuous orbital track 120.

Concertina Folded Bags and Cartons

Figure 5A shows an alternative sub-assembly sequence to that of Figure 2A.

In this arrangement, both bags 51 and carton blanks 41 are brought together from separate respective stacked concertina folded webs.

Once a carton 41 has been correctly located onto bag 51, it will be severed from subseqent carton 41 to enable individual carton 41 fold around a respective bag 51, remaining in bag web 55.

As before, neck retention collar 14 is attached and the resulting sub-assembly 71 is concertina folded for transport or storage.

Figure 5B shows a follow-on inflation / fill final assembly sequence to Figure 5A sub-assembly, with options supplementing basic steps of Figure 3A.

These options are depicted schematically as interventions - themselves detailed in Figures 6A and 6B.

Again, concertina folded sub-assemblies 71 are drawn from their stack and attached to an air hose / feed line before being severed from the next in line.

A bag 51 is then inflated / filled while the assembly is supported by its retention collar 14.

This allows carton 41 to take shape as bag 51 volume increases.

A final step is to close and seal top 42, 48, 56 and bottom 57, 58 carton flaps.

Cushion Floor

Figure 6A shows an optional final assembly stage - prior to closure of bottom carton flaps 57, 58 - of insertion of a cushion floor 15.

Such a floor 15 may be comprised of corrugated cardboard or like material, to help protect the bottom of bag 51 inside carton 41.

Thus, carton 41 base puncture or crush may be accommodated by the cushion flooring 15 and thus preserve the bag 51 intact.

Reinforcement/Bracing Sleeve

Alternatively, or additionally, a reinforcement or bracing sleeve or liner 16 may be inserted into carton 41 before final closure, as depicted in Figure 6B.

Bracing sleeve 16 bolsters overall carton strength and rigidity for larger and heavier capacties.

This is achieved without adoption of a higher or thicker grade cardboard for the entire carton body.

Thus, a bracing sleeve could be corrugated to provide vertical stacking strength, whilst an outer (non-corrugated) carton body provides splash and water protection.

Conversely, a corrugated carton body could make a bracing sleeve redundant.

Sleeve 16 also preserves overall rectangular carton form, for stacking consistency and protects bag 51 in the event of carton 41 side impact.

Stacking Plates

An optional step of grouping and packaging multiple BIB cartons after individual carton (150) erection is reflected in Figures 7A and 7B.

Top and bottom stacking plates 17 sandwich multiple - in this case dual or paired - adjacent BIB cartons (150) in a rectangular configuration.

Plates 17 are held together by tie bands 18 wrapped around the set at several points.

A final multiple (in this dual or paired) pack cluster option is depicted in Figure 7A.

This principle may be employed not for mutually entraining and securing identical BIB cartons (150) - but also sets of different sized cartons, scaled and stacked to form a substantially rectangular outer form - as shown in Figure 7B.

Web Rolled Bags and Cartons

Figures 8A and 8B show a variant of Figures 5A and 5B, whereby the bags 51 and cartons 41 are brought together from individual web rolls 91, 92.

Thus, bags 51 are successively unravelled from roll 91, whilst cartons - possibly of synthetic plastics material - are unravelled from roll 92.

Roll 92 feed is like unsuitable for corrugated cardboard material, which embodies a laid flat set in production.

However, roll feed might be tenable for single layer sheet or card or synthetic plastics, or even corrugated plastics where corrugations run parallel to the roll axis.

A sufficiently large roll diameter is envisaged to avoid material adopting a set curvature.

Carton Construction (Pre-Bag Insertion)

Figures 9A through 9H detail alternative BIB construction and/or (pre-)assembly - independently of and prefacing bag introduction.

Generally, carton 11 is almost fully formed before bag 12 is inserted and collar 14 attached.

An assembly sequence comprises:

- fold carton blank 11, bringing side panels 46 around to form open-ended wrap 47;
- (edge) seal side panels 46 together, using tab 19;
- fold down top flaps 56, 42, 48 and seal in place;
- insert bag 12 into carton 11 through open carton bottom;

{in practice, a carton collar could be lowered upon an inflated bag}

- attach collar 14 to bag 12 through carton aperture 43;
- close bottom flaps 57, 58 and seal in place.

Optionally, a pre-fabricated handle could also be fitted upon the carton - as shown in Figure 9G.

Alternatively, an integrated handle and collar top-plate could be fitted - as shown in Figure 9H.

Carton Construction Around Infated / Filled Bag

Figure 10 shows an alternative BIB assembly of bag 12 pre- inflation / fill and carton 11 build around it.

Sub-Assembly Construction

Figures 11A through 11C show sub-assembly from a bag roll 91 and individual carton blank elements 41.

Each successive individual bag 51 is overlaid with a respective carton blank 41.

Carton 41 is then folded in half around bag 51 until side panels 46 lie adjacent each other.

Carton side tab 19 is then glued or otherwise secured to adjacent side panel 46 edge.

Finally, collar 14 is attached to bag 51 and carton 41 to secure these elements together.

Figure 12 shows a stack of multiple individual BIB sub-assemblies 20.

Bracing Sleeve Insertion

Figures 13A through 13C illustrate insertion of bracing sleeve 16 into carton 41.

Bracing sleeve 16 may be of toughened cardboard material or corrugated as detailed in Figure 13C.

Bracing sleeve 16 is preferrably profiled to nest within carton 41 body and provide extra strength at the edges and corners - as illustrated in Figure 13B.

Corrugated Carton

The entire carton body 72 may be constructed from corrugated material - as shown in Figures 14A and 14B.

This may negate the need for an additional bracing sleeve in applications where box robustness is of prime consideration.

Corrugated cartons 72 may also be useful in applications where the carton does not require to be waterproof.

Collar Release Valve

Figures 15A and 15B illustrate how collar 14 recess may act as a safety release valve when the BIB is dropped.

As a carton 41 is crushed from beneath, internal bag 51 is forced upwards.

This forces out recess panel 73 which in turn pushes out attached collar 14 with intrained bag neck 52.

As can be seen from Figure 15B bag 51 then has more room in which to move away from the crushed carton below.

This may mean bag 51 can stay intact despite carton 41 crush.

Cushion Pad

A cushion pad 74 may be accomodated within carton 41 as shown in Figure 16.

This cushion pad 74 may be filled with air and placed on top of bag 51, adjacent the underside of recess panel 73.

As air or gas is more readily compressed than liquid, this cushion pad 74 may crush before bag 51 liquid contents.

Integrated Bag & Collar

A bag may be integrated with a collar 82.

This may then be inserted into a carton 83 as shown in Figure 17.

Carton 83 is provided with an opening 84 into which bag 82 is fed until attached collar seals opening 84.

Collar & Bag Restraint

Collar 14 and entrained bag neck 52 are restrained from rotational movement by carton 41 recess profile.

Thus, as a screw cap 62 is applied, the resulting torque does not twist the collar 14 or bag 51 inside the carton 41 - as illustrated in Figure 18.

Moulded Plastic Carton

Figures 19A and 19B show a variant carton 93 configured from a moulded plastics sheet.

Collar 14 is thus integrated into the carton 93 form, negating the need for attachment of an additional collar 14 element.

Other features may also be moulded into a plastic carton blank.

Figures 20A and 20B show a variant of the above with a plastic handle cut-out incorporated into carton 94.

'Mix and Match' Features

Generally, in the embodiments, where feasible and appropriate, features may be selectively 'mixed and matched' to suit circumstances - albeit it is not feasible to describe every such feature combination.

Component List

11	box / carton
12	bag
13	handle
14	collar
15	cushion floor
16	bracing sleeve
17	stacking plate
18	tie band
19	side tab

20 sub-assembly
30 final assembly

40 cassette store
41 carton
42 top flap
43 neck aperture
44 handle aperture
45 side edge
46 end flaps
47 wrap
48 top closure flap
49 top flap corner edge fold

50 cassette store
51 bag element
52 bag neck
55 bag web
56 top closure side flaps
57 bottom side flaps
58 bottom end flaps

60 cassette store
61 collar aperture
62 cap

70 cassette store
71 sub-assembly web
72 corrugated carton
73 recess panel
74 cushion pad

80 conveyor bed
81 conveyor guides
82 integrated bag & collar
83 carton
84 opening

90 handle station
91 bag roll
92 carton roll
93 moulded carton
94 moulded carton with handle

100 sub-assembly line
110 inflation test station
111 valve cap

112 feed pipe
113 air pressure supply
114 rotary (swivel) connector valve

120 conveyor
130 end flap closure station
140 contents fill station
150 erect BIB